

Precision Input Cost Management: Focus on Nitrogen

Darrin Dodds

Mississippi State University



Disclaimer

- *Cotton Incorporated will neither confirm nor deny my existence, let alone agree with or disagree with any of the thoughts or data provided henceforth. The thoughts presented from this point forward are done so by a guy from Illinois who works cotton in Mississippi.*
- *Dealing with any aspect of cotton production may produce the highest of highs, the lowest of lows, and may lead to the need for a banker, a preacher, a doctor, a liquor store, a gun salesman, or a combination of all.*

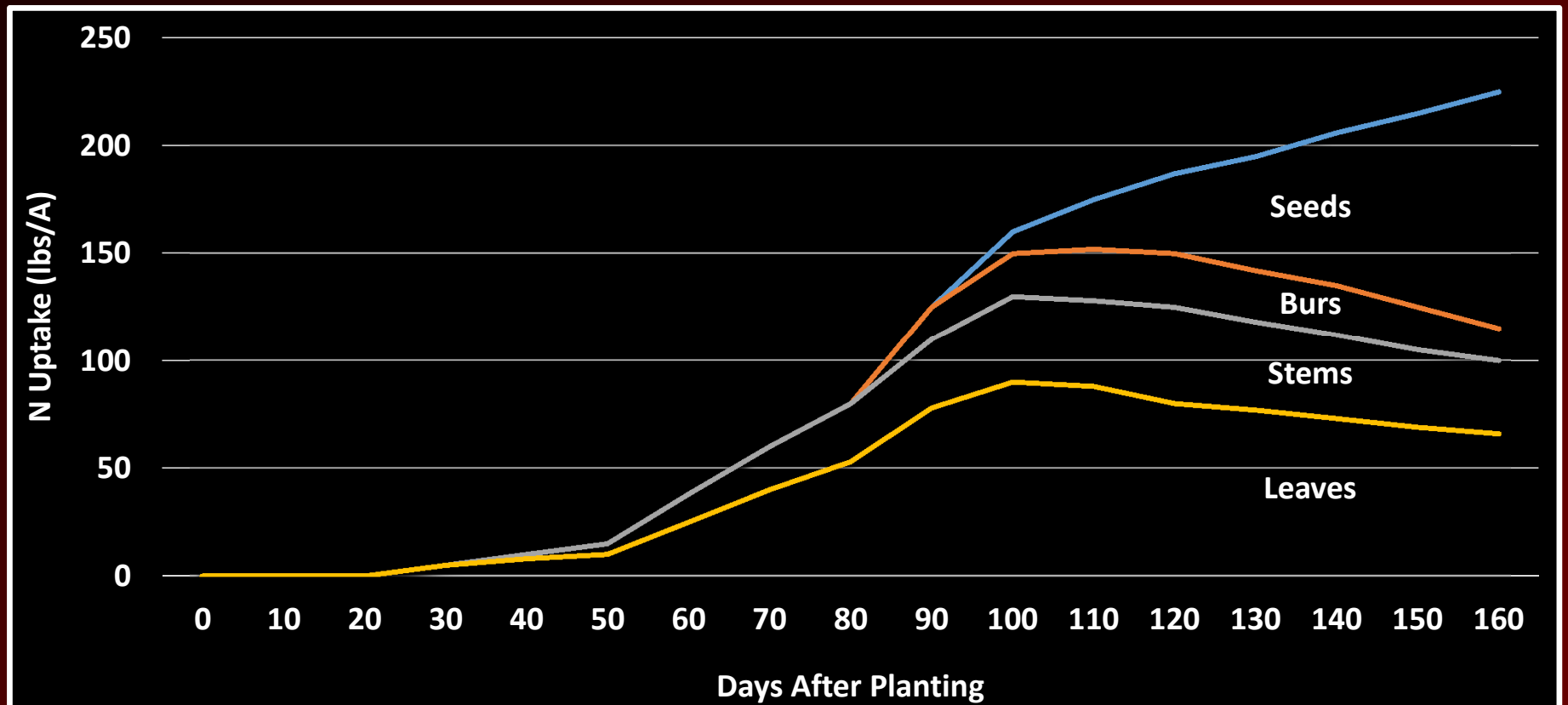
Nitrogen

- **Provided to the plant in greatest quantity**
 - Not used efficiently by the plant (Hunt et al. 1998; Hutmacher et al. 2004)
- **Significant expense**
 - \$350 – \$450 per ton depending on which dealer you talk to
 - 1 ton = 181 gallons (11.06 lbs/gallon)
 - 1 gallon = 3.54 lbs N
 - 1 ton = 640 lbs N
 - 100 lbs/Ac = \$55-\$70 per acre
- **Bollgard II/Roundup Ready Flex Technology fee in GA: \$412.20 per bag**
- **45,000 seeds per acre = \$74.20 per acre Technology Fees**

Nitrogen Recommendations

- **Georgia: Based on yield goal**
 - 750 lbs/A = 60 lbs N/A
 - 1000 lbs/A = 75 lbs N/A
 - 1250 lbs/A = 90 lbs N/A
 - 1500 lbs/A = 105 lbs N/A
- **South Carolina:**
 - Dryland = 70 lbs N/A
 - Irrigated = 90 lbs N/A
 - Adjust both up or down 20-30 lbs/A depending on yield potential and field history
- **Mississippi: Based on yield goal & soil texture**
 - 50-60 lbs N/bale on light textured soils
 - 60-70 lbs N/bale on medium textured soils
 - 70-80 lbs N/bale on heavy soils
- **Average application rates:**
 - Georgia: 70 – 120 lbs/A
 - South Carolina: 90 – 120 lbs/A
 - Mississippi: 90 – 120 lbs/A

N Uptake and Partitioning By Cotton



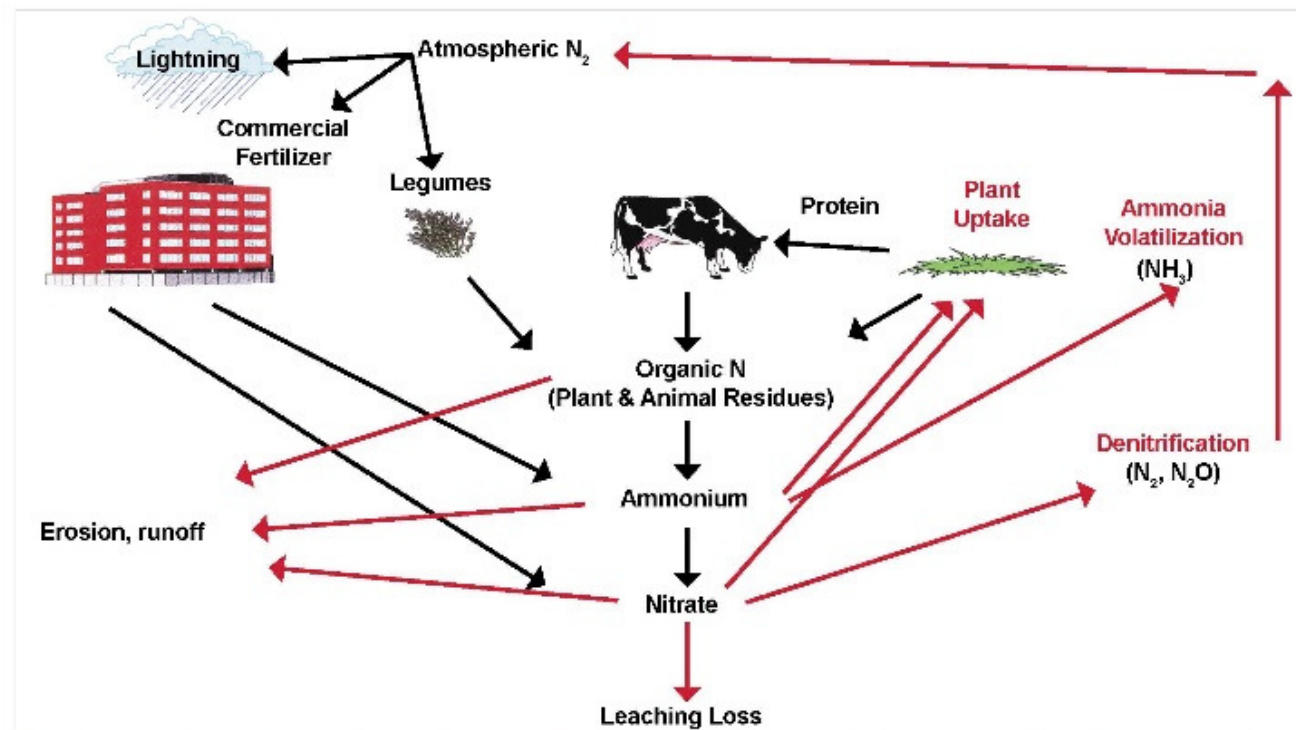
Source: Univ. of Arizona

Nitrogen Removal

	Yield/A	N	P ₂ O ₅	K ₂ O	Ca	Mg	S	Cu	Mn	Zn
Seed & Lint	2600	63	25	31	4	7	5	0.18	0.33	0.96
Stalks, Leaves, & Burs	3000	57	16	72	56	16	15	0.05	0.06	0.75

- **2600 lbs seed & lint = 1000 lbs lint**
- **What about a 1500 lb crop?**
- **Question: If we are applying 120 lbs and removing 63 – 94 lbs, where is the remainder?**

The Nitrogen Cycle



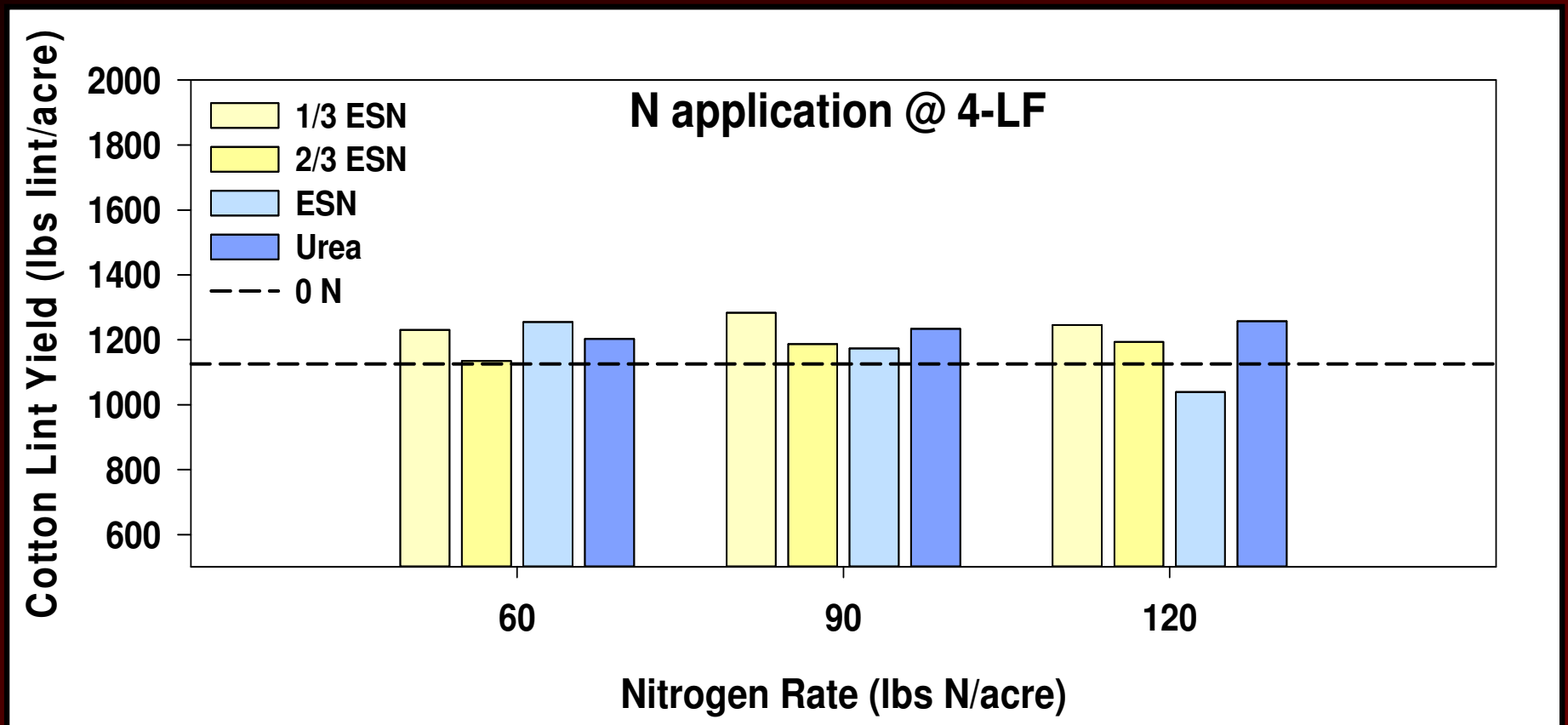
The nitrogen cycle, including most inputs, losses and transformations. Red arrows indicate potential losses from soils, while black arrows indicate inputs or transformations.

The Eternal Question

- How much nitrogen should I apply?
- Answer: depends
- Things to consider:
 - Yield potential
 - Field history
 - Previous crop
 - Soil texture
 - Nitrogen source
 - Application method

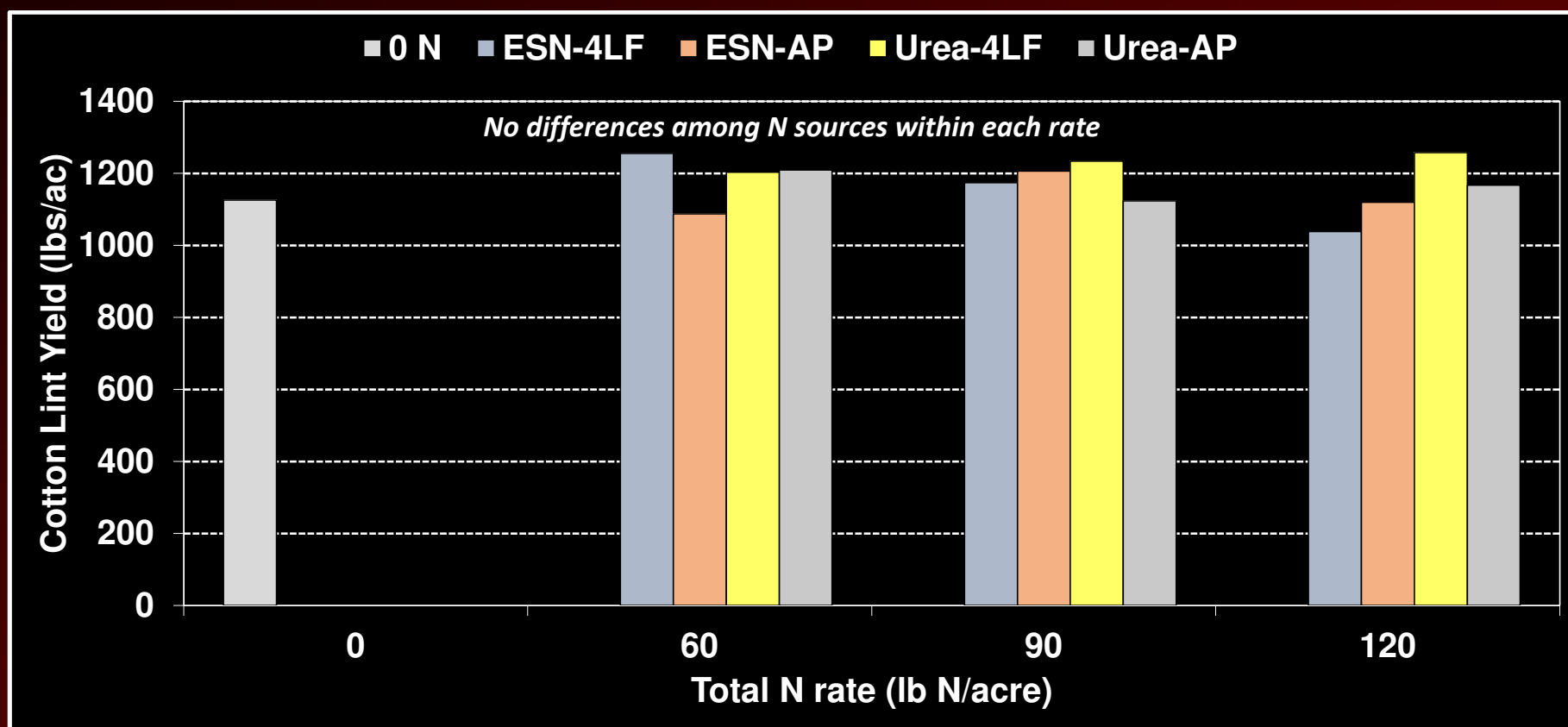


Mississippi Cotton 2011



Source: Dr. Bobby Golden

Cotton Yield Response to Nitrogen



Source: Dr. Bobby Golden

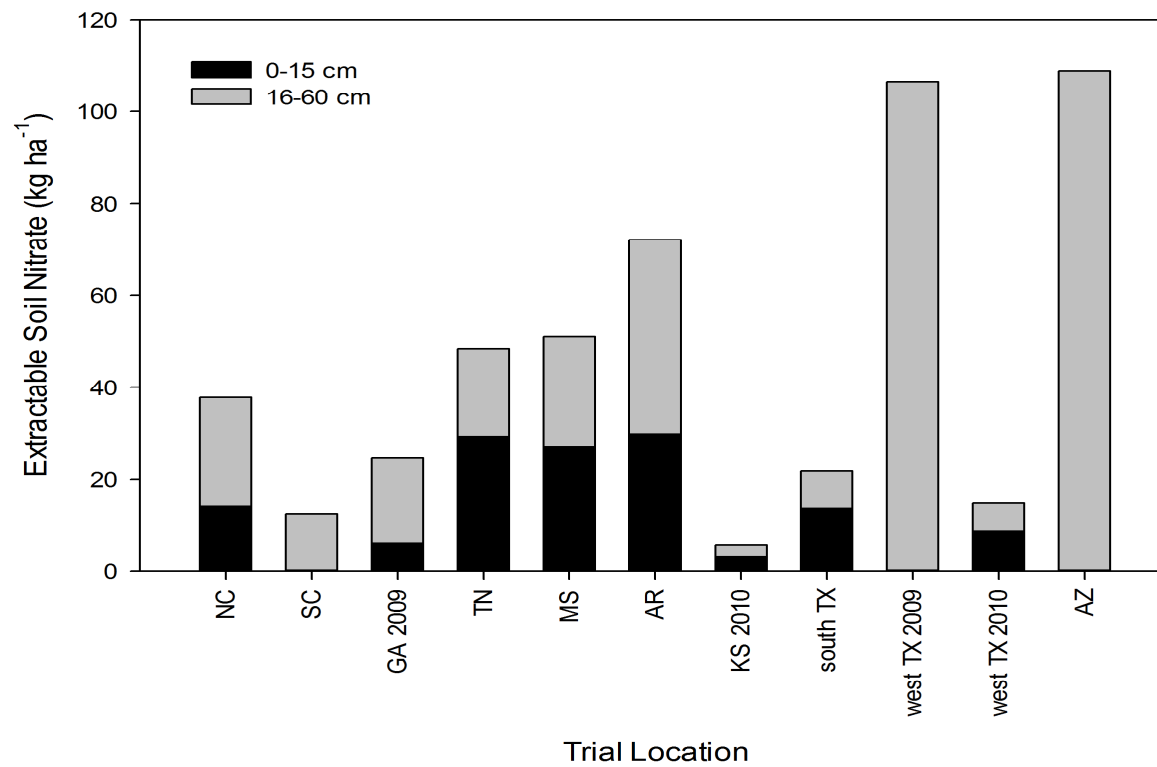
No Yield Response to Nitrogen???

- **Is Bobby Golden a lunatic?**
- **20 studies were conducted across the Cotton Belt in 2009 and 2010**
 - 11 of 20 locations had no response to nitrogen
- **Why was there no response to N in so many studies?**
 - “This is why research isn’t relative on my farm”
- **Mentality**

Pre-Sidedress Soil Nitrate Tests

- Have been beneficial for predicting N fertilizer needs in other crops
- Not used to a great extent in cotton production
- Beltwide N project confirmed residual NO_3^- is present in Cotton Belt soils
- Data indicates that 21 lbs N are required per bale of lint produced

Extractable Soil Nitrate

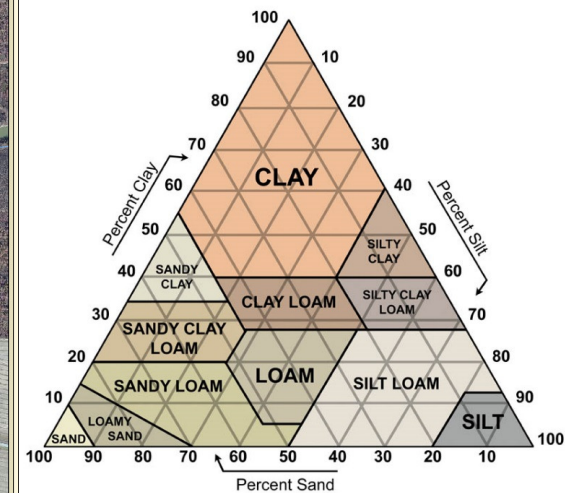
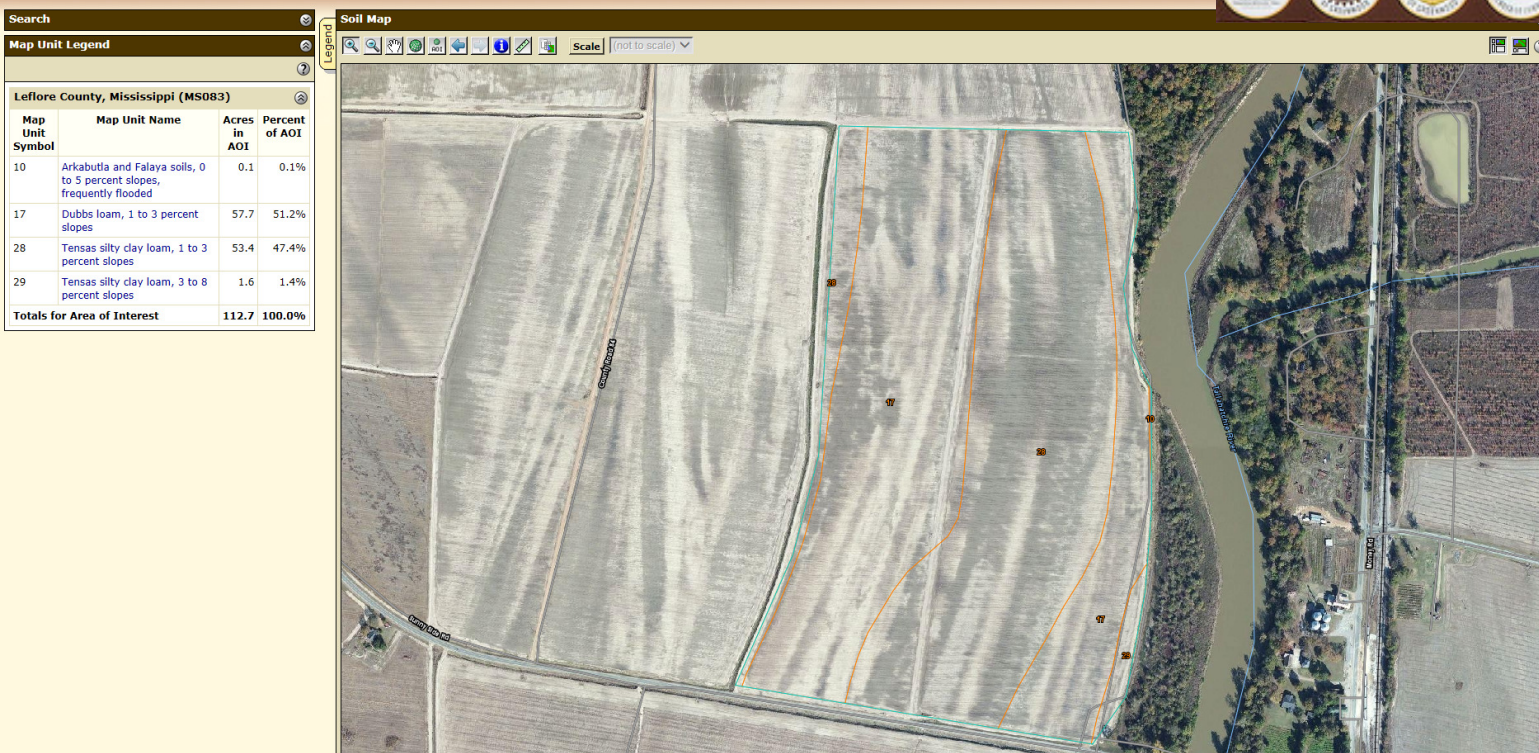


Source: Main et al. 2013

Field Variability

Welcome to
GREENWOOD

*Cotton Capital
of the World*



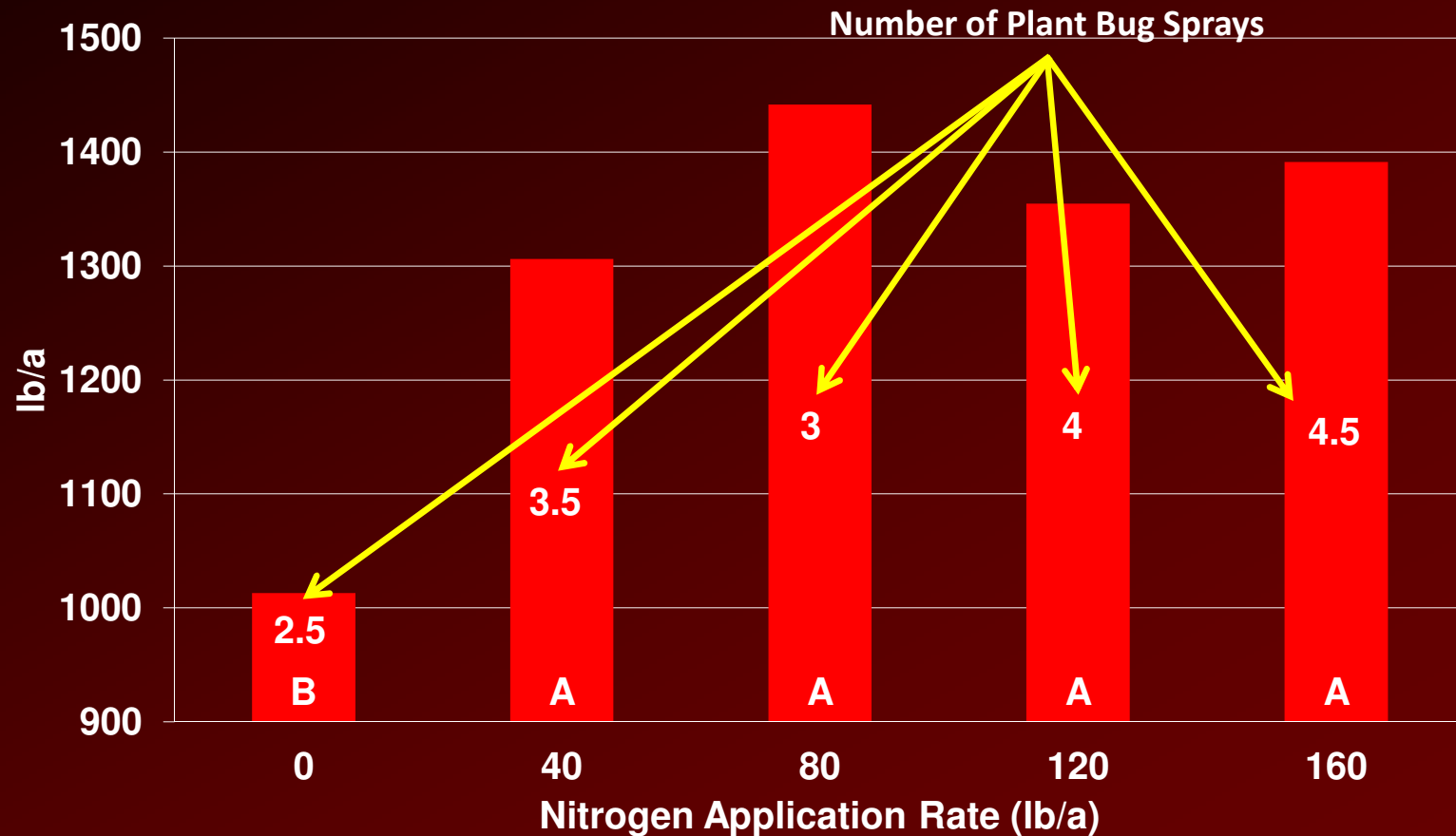
Source: www.soilsensor.com

Effects of Excessive Nitrogen Application

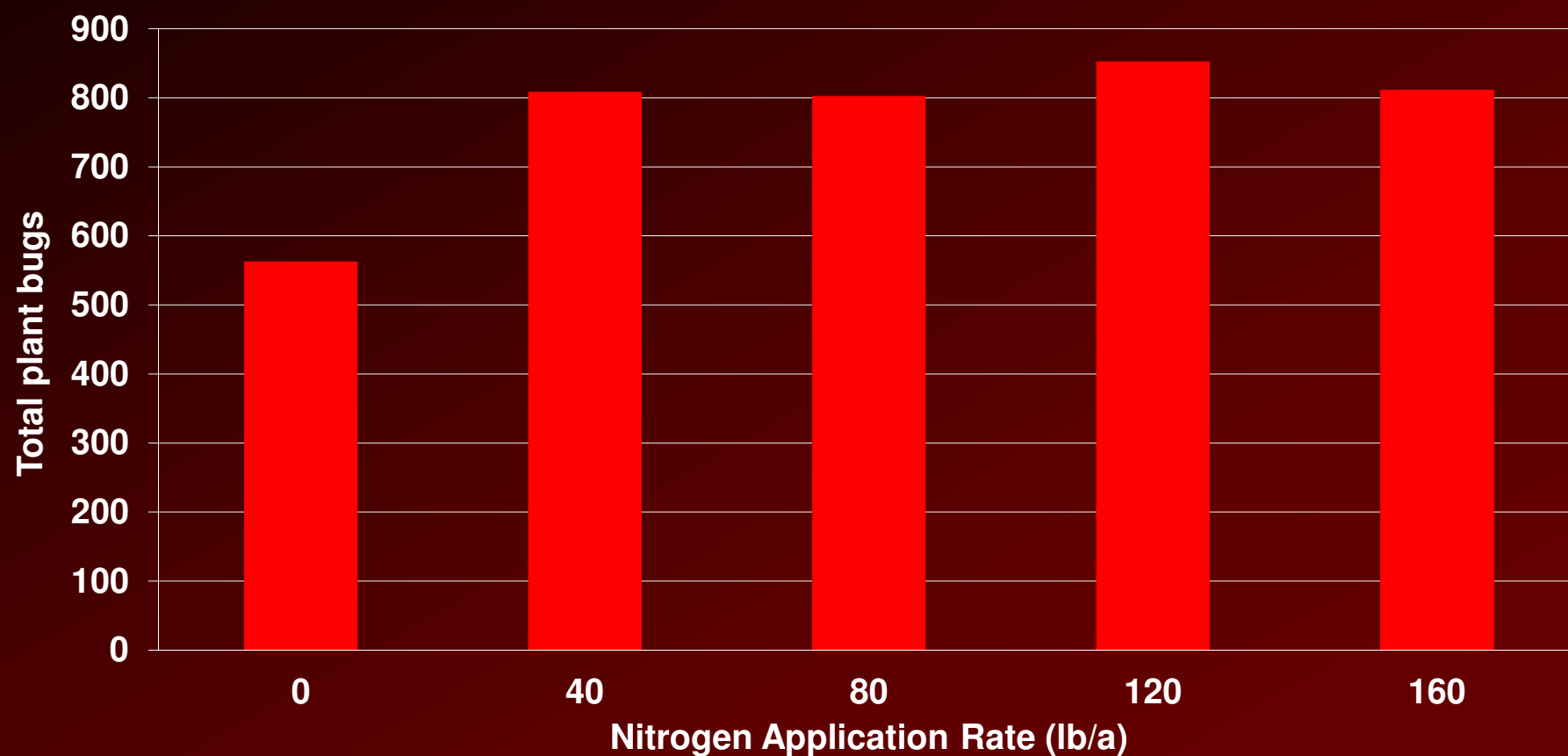
- **Alter vegetative and reproductive growth**
- **Delay maturity**
 - Clawson et al. 2008
 - Varco et al. 1999
- **Insects are drawn to rank, lush cotton**
 - Willers et al. 2001
- **Decrease profitability**

Nitrogen	Plant height	Plant nodes	NACB ¹
Lb/A	Inches	#	
0	29.2	16.6	4.3
40	31.4	17.1	4.9
80	33.1	18.0	5.3
120	34.7	18.5	5.9
LSD (0.05)	0.9	1.0	0.5

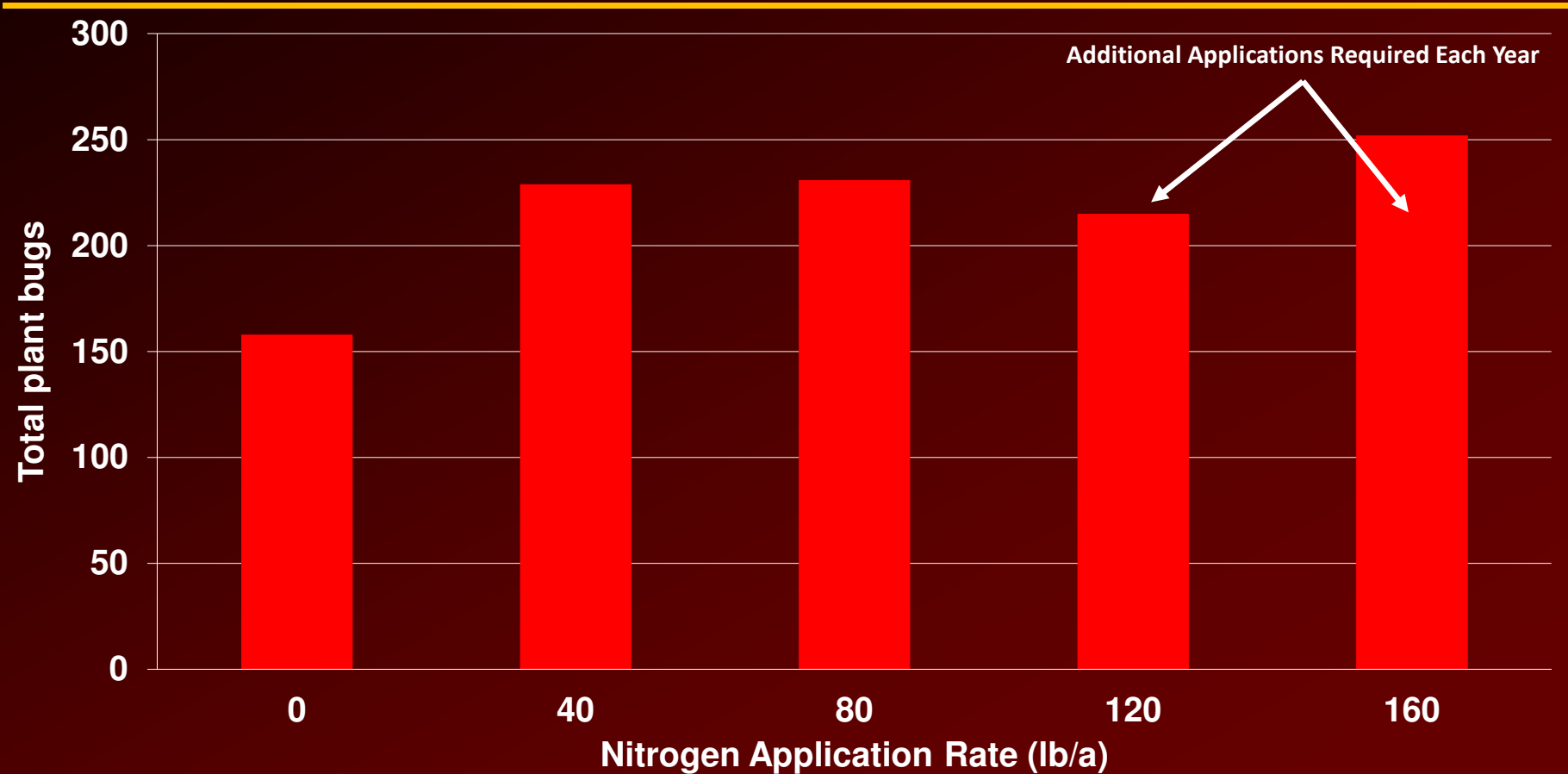
Nitrogen Application Rates and Tarnished Plant Bugs



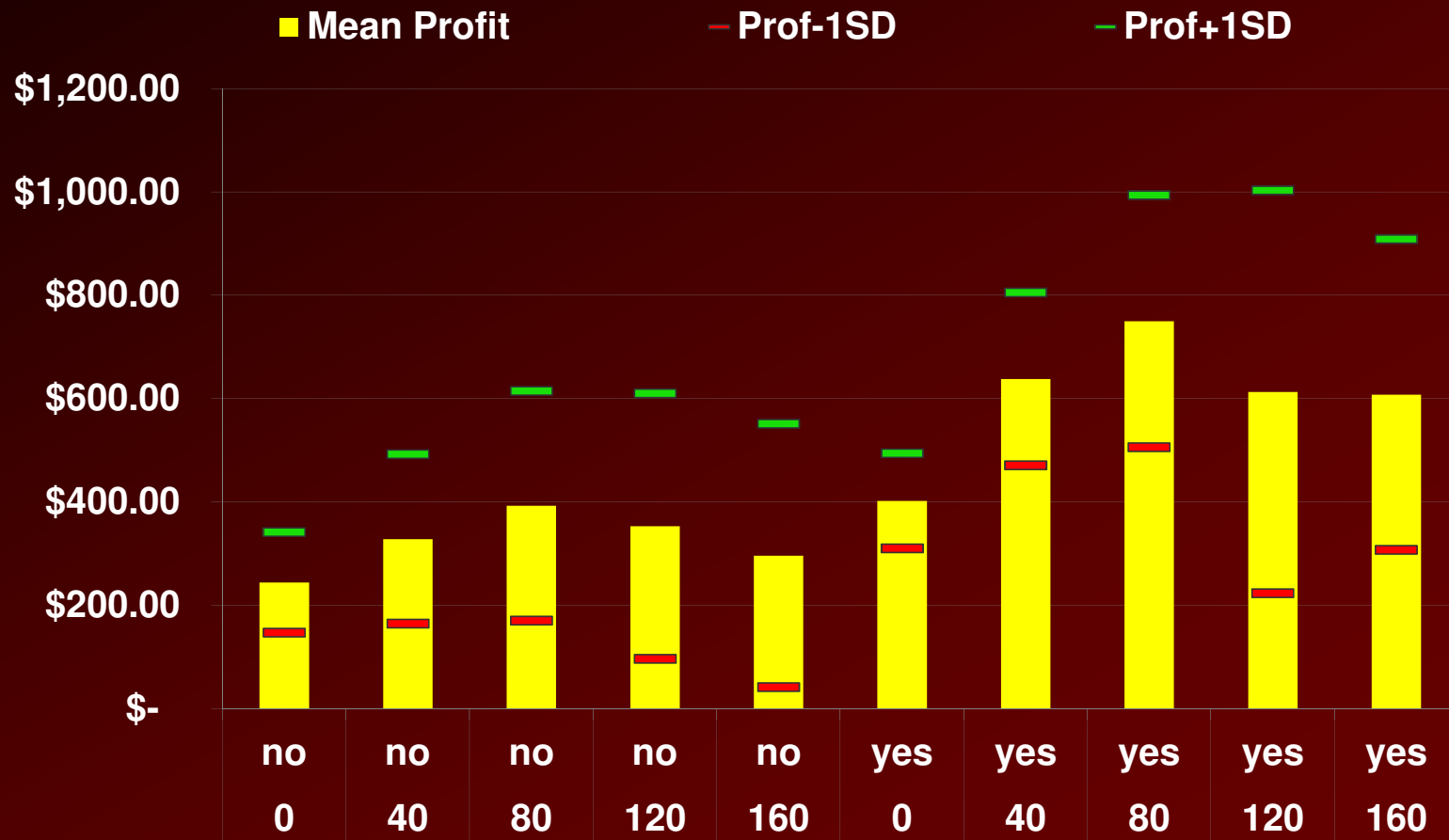
Total Plant Bugs – Unsprayed Plots



Total Plant Bugs – Sprayed Plots



Profitability



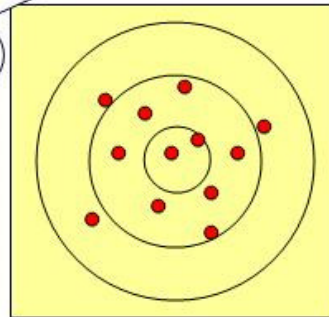
Where Are We Going?

- **Precision agriculture**
 - Somewhat of a misnomer
- **Field management on a spatial level**
 - Multiple factors may need to be included to get the most bang for your buck
- **More convenient access to massive amounts of reliable data than ever before**



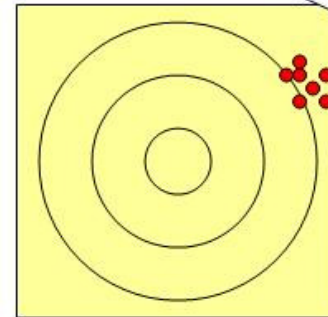
Accuracy vs Precision

*Measure of
bias*

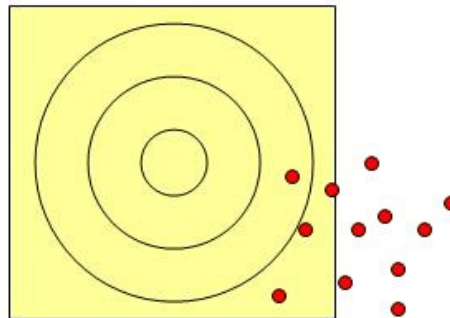


Accurate but not Precise

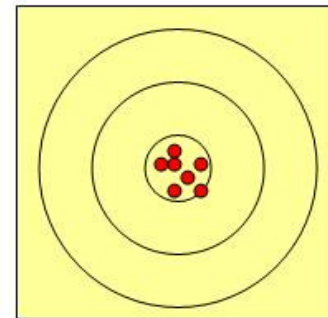
*Measure
of spread*



Precise but not Accurate



Not Accurate or Precise



Both Accurate & Precise

Where Are We Going?

- **Precision agriculture**
 - Somewhat of a misnomer
- **Field management on a spatial level**
 - Multiple factors may need to be included to get the most bang for your buck
- **More convenient access to massive amounts of reliable data than ever before**

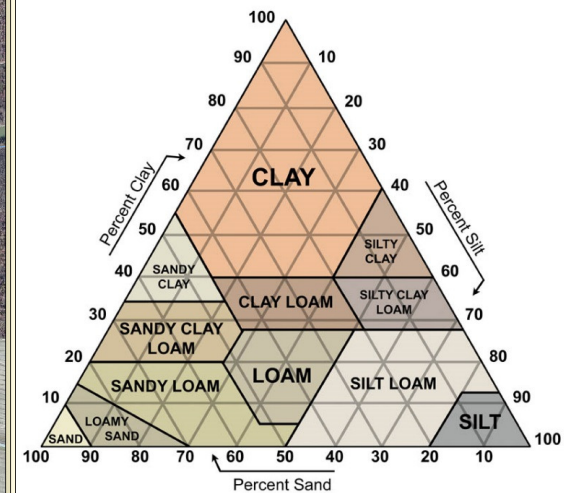
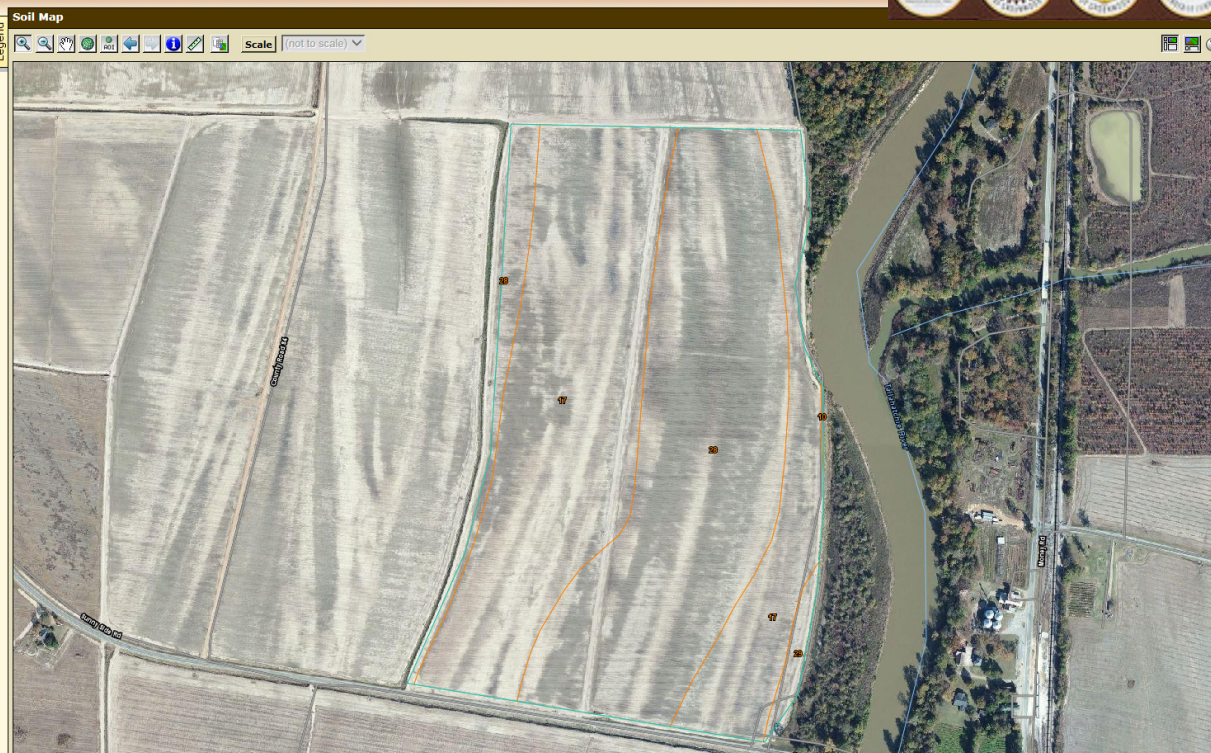


Welcome to
GREENWOOD
Cotton Capital
of the World

The logo features two stylized cotton plants flanking the central text. Below the main title is a row of ten circular logos representing various organizations:

- United States Department of Agriculture
- Agricultural Research Service
- Cotton Incorporated
- National Cottonseed Council
- USDA Forest Service
- USDA Wildlife Service
- USDA Natural Resources Conservation Service
- USDA National Forest System
- USDA Bureau of Land Management
- USDA Fish and Wildlife Service

Search			
Map Unit Legend			
Leflore County, Mississippi (MS083)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
10	Arkabutla and Falaya soils, 0 to 3 percent slopes, frequently flooded	0.1	0.1%
17	Dubbs loam, 1 to 3 percent slopes	57.7	51.2%
28	Tensas silty clay loam, 1 to 3 percent slopes	53.4	47.4%
29	Tensas silty clay loam, 3 to 8 percent slopes	1.6	1.4%
Totals for Area of Interest		112.7	100.0%



Source: www.soilsensor.com

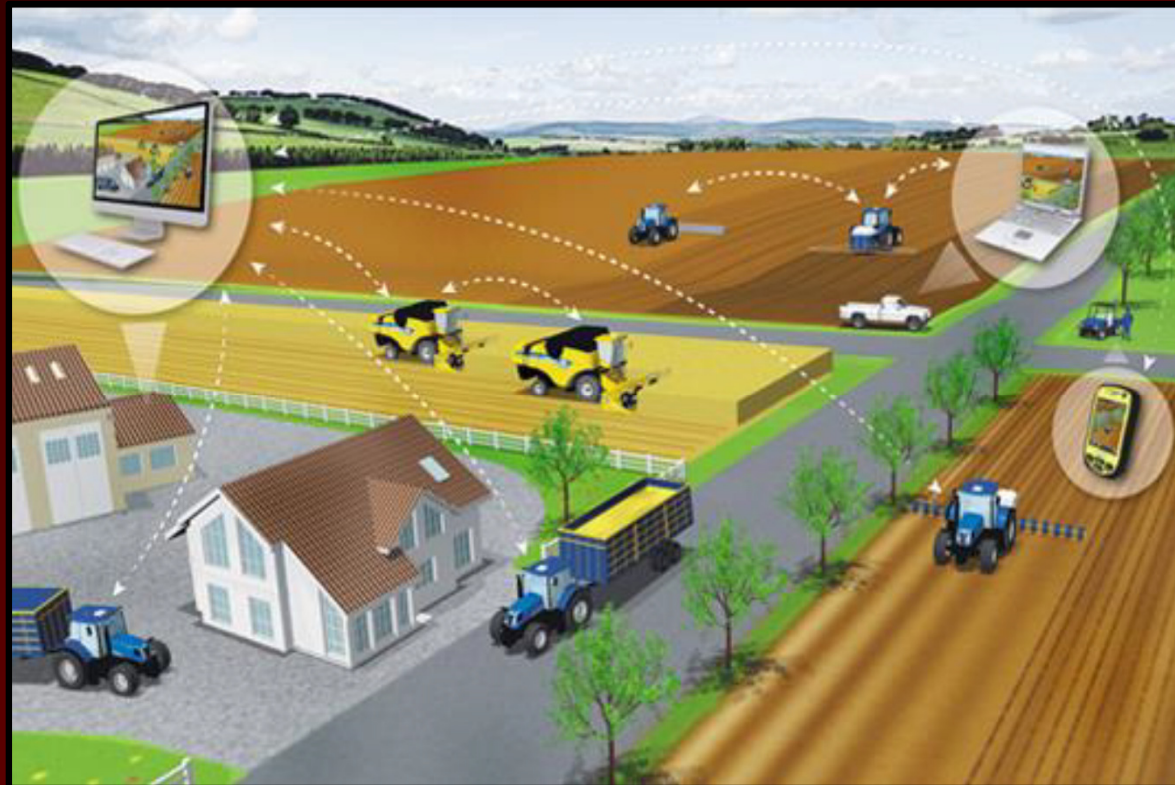
Where Are We Going?

- Precision agriculture
 - Somewhat of a misnomer
- Field management on a spatial level
 - Multiple factors may need to be included to get the most bang for your buck
- **More convenient access to massive amounts of reliable data than ever before**



Information Collection and Processing

- Agriculture has seen unprecedented advances in information collection capabilities
- Soil maps, Veris maps, site-specific soil sampling, application maps, yield maps, elevation, etc...
- What do we do with this data?



Nitrogen Recommendations

- **Georgia: Based on yield goal**
 - 750 lbs/A = 60 lbs N/A
 - 1000 lbs/A = 75 lbs N/A
 - 1250 lbs/A = 90 lbs N/A
 - 1500 lbs/A = 105 lbs N/A
- **South Carolina:**
 - Dryland = 70 lbs N/A
 - Irrigated = 90 lbs N/A
 - Adjust both up or down 20-30 lbs/A depending on yield potential and field history
- **Mississippi: Based on yield goal & soil texture**
 - 50-60 lbs N/bale on light textured soils
 - 60-70 lbs N/bale on medium textured soils
 - 70-80 lbs N/bale on heavy soils
- **Average application rates:**
 - Georgia: 70 – 120 lbs/A
 - South Carolina: 90 – 120 lbs/A
 - Mississippi: 90 – 120 lbs/A

Closing Thoughts

- **Given current market prices and environmental concerns, we must continue to refine and improve nitrogen use efficiency**
- **Willingness to change/adapt**
- **Experiment**
- **Change is going occur**
 - **“Shift happens”**

Thank You

- **Contact information:**
- **Darrin Dodds**
- **Mississippi State University**
- **darrind@ext.msstate.edu**
- **Cell: 662-418-1024**
- **Twitter: @DarrinDodds**
- **Blog: www.mississippi-crops.com**

Questions

